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ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/934,320	CALVERT ET AL.	
	Examiner	Art Unit	
	Akash Saxena	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 21 August 2001.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-29 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-29 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 3/21/2002.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-29 have been presented for examination based on the application filed on 21st August 2001.

Priority

2. Applicant's claim for domestic priority under 35 U.S.C. 119(e) is acknowledged from provisional application no. 60/229,407 filed on 31st August 2000.

Claim Objections

3. Claim 25 is rejected, as examiner does not understand how to interpret the claim. Examiner respectfully suggests modifying the claim language as follows:

> "The method of claim 24, wherein one of the steps includes replacing tentative rock-property values, in blocks intersected by the boreholes of wells, by corresponding values observed at each ~~intersected~~ intersecting borehole segment."

4. Claim 29 is objected to as there is step(m) in the disclosed sequence of steps.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,049,759 issued to John T. Etgen (Etgen '759 hereafter), in view of U.S. Patent No. 4,679,174 issued to Valery A. Gelfand (Gelfand '174 hereafter).

Regarding Claim 1

Etgen '759 teaches

> "A method for constructing a three-dimensional geologic model of a subsurface earth volume according to specific geological criteria, comprising the steps of:
> (a) generating an initial frequency-pass band model of the subsurface earth volume for at least one frequency pass band;"

as creating a 3-D model for the subsurface geological feature (Etgen '759: Col.15 Lines 15-22) according to specified geological criteria (Etgen '759: Col.17, Lines 38-41, 48-63). Further, Etgen '759 teaches generating an initial frequency-pass bānd model for one frequency of the subsurface earth volume (Etgen '759: Col.6 Lines 22-26; Col.7 Lines 5-30).

Further, Etgen '759 teaches

> "(b) assigning values for at least one rock property in each initial frequency-passband model;"

as assigning a velocity model consisting of horizontally layered constant velocity media within area of interest (Etgen '759: Col.5 Lines 41-47; Col.17, Lines 38-41, 48-63) to the single frequency model (Etgen '759: Col.6 Lines 1-3, 22-26). Further, Etgen '759 teaches that other sources like well data can be combined to enhance the single frequency model (Etgen '759: col.16 Lines 61-67).

Further, Etgen '759 teaches

> "(c) combining the initial frequency-passband models to form an initial complete three-dimensional geologic model of the subsurface earth volume; and"

as summing up all the individual frequency models to create a complete three-dimensional geological model (Etgen '759: Col.7 Lines 33-35).

Etgen '759 does not teach

> "(d) optimizing the initial complete three-dimensional geologic model by perturbing the rock property values in at least one of the models according to specified geological criteria."

Gelfand '174 teaches optimizing the initial model by the process of perturbing the rock properties (Gelfand '174: Abstract).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to take the teachings of Gelfand '174 and apply them to Etgen '759 to create a 3D geological model from various frequencies and perturb the rock data to achieve the desired degree of correspondence with real data. Although Gelfand '174 is teaching a 2-D Model geological model, the motivation to combine would be that Gelfand '174 teaches the process of geological modeling using the process of perturbing, which can change the underlying geological model to achieve the desired result in iterative steps (Gelfand '174: Abstract). Etgen '759 teaches performing 3-D seismic analysis and model but processes the information much more efficiently (converting the data to frequency domain using Fourier transform) as the data collected is much more (Etgen '759: Col.1 Lines 40-45). Combing the two reference will yield more truer picture 3-D geological model (Etgen '759: Col.3 Lines 14-20) and perturbation will make the model more precise to actual (Gelfand '174: Abstract).

Regarding Claim 2

Gelfand '174 teaches that the tentative passband model can be made out of all the frequencies of 0-200 Hz (Gelfand '174: Col.3 Lines 44-55). This spectrum includes

the low (0-20Hz), medium (20-56 Hz) and high band (56 Hz >) as defined by the specification (Specification: Pg.9 [0022]).

Regarding Claim 3

Etgen '759 teaches that seismic frequency passband is represented by the mid-frequency passband (Etgen '759: Col 25 Lines 17-26).

Regarding Claim 4

Gelfand '174 teaches that existing geologic model is full frequency passband (Gelfand '174: Col.2, Lines 49-56).

Regarding Claim 5

Gelfand '174 teaches that initial model is made based on the limits defined in the region and stratigraphics (Gelfand '174: Col.4 Lines 25-36). Etgen '759 teaches 3-D array (matrix) of contiguous model blocks representing the portions of subsurface earth volume (Etgen '759: Col.6 Lines 22-26; Figure 8A).

Regarding Claim 6

Claim 6 is rejected for the same reasons as claim 5 as specification discloses blocks and points to the analogous (Specification: Pg.1 [0002]) and is not enabled to provide the distinction between the claimed blocks and points.

Regarding Claim 7

Etgen '759 teaches that rock properties are measurable properties consisting of P velocity, S velocity, attenuation/dissipation (Q), density, porosity, and permeability (Etgen '759: Col.17 Lines 58-63)(Gelfand '174: Col.2 Lines 1-3).

Regarding Claim 8

Gelfand '174 teaches that pluralities of rock properties are associated to the acoustic propagation velocity (Gelfand '174: Col.1, Lines 50-57, 65-68; Col.2 Lines 1-3). Etgen '759 teaches that velocity models are assigned to frequency models (Etgen '759: col.6 Lines 1-8).

Regarding Claim 9

Gelfand '174 teaches that rock properties assigned to the model can be verified with the real well data (Gelfand '174: Col.2 Lines 4-12).

Regarding Claim 10 &11

Etgen '759 teaches geologic model can be made from one frequency or a summation of frequencies (frequency-passband)(Etgen '759: Col7 Lines 18-35).

Regarding Claim 12

Etgen '759 teaches summation of frequency models as detailed in claim 11 above. Further, weighted summation is understood as convolution before summation, taught by Etgen '759, performed with frequency specific seismic data in frequency domain (through Fourier Transform) (Etgen '759: Col.5 Lines 41-51). Further, frequency filtering is performed so weighted summation of frequency models is not needed as overlaps are reduced (Etgen '759: Figure 2 Element 100).

6. Claims 13-25, 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,049,759 issued to John T. Etgen (Etgen '759 hereafter), in view of U.S. Patent No. 4,679,174 issued to Valery A. Gelfand (Gelfand '174 hereafter), further in view of U.S. Patent No. 5,838,634 issued to Thomas A. Jones et al (Jones '634 hereafter).

Regarding Claim 13

Teachings & motivation to combine Etgen '759 & Gelfand '174 are disclosed in the claim 1 rejection above. Gelfand '174 teaches step (d) limitation of perturbing the rock data (Gelfand '174: Abstract).

Etgen '759 & Gelfand '174 do not teach training remaining limitation of claim 13. Jones '634 teaches the following as shown below.

Jones '643 teaches Step (a) as specifying training information corresponding to the desired components or criteria consistent with the model (Jones '643: Col.18 Lines 34-36).

Jones '643 teaches Step (b) as calculating statistics for the properties of initial model (Jones '643: Col.18 Lines 36-39).

Jones '643 teaches Step (c) as calculating objective function (Jones '643: Col.19 Lines 4-10).

Jones '643 teaches Step (d) as perturbing the rock properties (Jones '643: Col.19 Lines 30-33). Gelfand '174 also teaches perturbing as shown above.

Jones '643 teaches Step (e) as calculating the objective function for the new tentative model (Jones '643: Col.20 Lines 51-52).

Jones '643 teaches Step (f) as retaining perturbed rock property values and the new tentative objective function if the objective function is reduced (Jones '643: Col.20 Lines 60-67).

Jones '643 teaches Step (g) as repeating the steps (d) through (f) until the objective function is reduced to a specified limit (Jones '643: Col.21 Lines 13-21).

Jones '643 teaches Step (h) as outputting the geological model to a file (Jones '643: Col.21 Lines 22-23).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to take the teachings of Etgen '759 with Jones '643 to create frequency-passband geological model. The motivation would have been that frequency pass-band based geological models proposed by the Etgen '759 are not optimized based on the ability to perturb individual rock properties and Jones '643 provides that capability (Jones '643: Col.6 Lines 62-65) leading to better trained model based on iteration. Further motivation to combine comes from Etgen '759 as performing transformation speeds up the depth-amplitude-time seismic data processing (Etgen '759: Col.5 Lines 41-58; Jones '643: Col.9 Lines 15-21, Col.10 Lines 38-41).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to take the teachings of Gelfand '174 with Jones '643 to create 3-D geological model where rock properties are perturbed to enhance the model. The motivation would have been that Gelfand '174 performs the same process as Jones '643, but builds a 2-D geological model (Gelfand '174:

Abstract) where as Jones '643 teaches how to build a 3-D geological model with separate objective function to accuracy of the model (Jones '643: Abstract).

Regarding Claim 14

Etgen '759 teaches storing the output of the frequency models (Etgen '759: Col.28 Lines 7-17).

Regarding Claim 15

Jones '643 teaches that training criteria are specified for each region depending on the realistic and accurate data (from borehole & well data), hence is unique to that region (Jones '643: Col.8 Lines 51-55; Col.9 Lines 59-63).

Regarding Claim 16 & 17

Etgen '759 teaches many frequency models (Etgen '759: Col.7 Lines 33-35). Etgen '759 does not teach perturbing for each model directly and is also mute over retaining the frequency content of the model.

Jones '643 teaches iterative perturbing to create a new tentative model for one model (Jones '643: Abstract).

Further, Jones '643 teaches that tentative models are perturbed through modification of the rock properties only. Hence rest of the 3-D model content is unaffected (Jones '643: Col.10 Lines 13-20).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to apply teachings of Jones '643 to Etgen '759 and perform iterative perturbing to one or more frequency models to get the best geological model. Further, modifying the rock properties would not affect the frequency content of the models as from Jones '643 teachings. The motivation

would have been to achieve the realistic and accurate result for the 3D model (Jones '643: Col.9 Lines 59-63).

Regarding Claim 18

Etgen '759 teaches step (a) as creating a 3-D model for the subsurface geological feature (Etgen '759: Col.15 Lines 15-22) according to specified geological criteria (Etgen '759: Col.17, Lines 38-41, 48-63). Further, Etgen '759 teaches generating an initial frequency-pass band model for one frequency of the subsurface earth volume (Etgen '759: Col.6 Lines 22-26; Col.7 Lines 5-30).

Further, Etgen '759 teaches step (b) as assigning a velocity model consisting of horizontally layered constant velocity media within area of interest (Etgen '759: Col.5 Lines 41-47; Col.17, Lines 38-41, 48-63) to the single frequency model (Etgen '759: Col.6 Lines 1-3, 22-26). Further, Etgen '759 teaches that other sources like well data can be combined to enhance the single frequency model (Etgen '759: col.16 Lines 61-67).

Further, Etgen '759 teaches step (c) as summing up all the individual frequency models to create a complete three-dimensional geological model (Etgen '759: Col.7 Lines 33-35).

Etgen '759 does not teach steps (d)-(l).

Gelfand '174 teaches step (d) as optimizing the initial model by the process of perturbing the rock properties (Gelfand '174: Abstract).

Jones '643 teaches Step (e) as specifying training information corresponding to the desired components or criteria consistent with the model (Jones '643: Col.18 Lines 34-36).

Jones ‘643 teaches Step (f) as calculating statistics for the properties of initial model (Jones ‘643: Col.18 Lines 36-39).

Jones ‘643 teaches Step (g) as calculating objective function (Jones ‘643: Col.19 Lines 4-10).

Jones ‘643 teaches Step (h) as perturbing the rock properties (Jones ‘643: Col.19 Lines 30-33). Gelfand ‘174 also teaches perturbing as shown above.

Jones ‘643 teaches Step (i) as calculating the objective function for the new tentative model (Jones ‘643: Col.20 Lines 51-52).

Jones ‘643 teaches Step (j) as retaining perturbed rock property values and the new tentative objective function if the objective function is reduced (Jones ‘643: Col.20 Lines 60-67).

Jones ‘643 teaches Step (k) as repeating the steps (h) through (j) until the objective function is reduced to a specified limit (Jones ‘643: Col.21 Lines 13-21).

Jones ‘643 teaches Step (l) as outputting the geological model to a file (Jones ‘643: Col.21 Lines 22-23).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to take the teachings of Gelfand ‘174 and apply them to Etgen ‘759 to create a 3D geological model from various frequencies and perturb the rock data to achieve the desired degree of correspondence with real data. Although Gelfand ‘174 is teaching a 2-D Model geological model, the motivation to combine would be that Gelfand ‘174 teaches the process of geological modeling using the process of perturbing, which can change the underlying geological model to achieve the desired result in iterative steps (Gelfand ‘174:

Abstract). Etgen '759 teaches performing 3-D seismic analysis and model but processes the information much more efficiently (converting the data to frequency domain using Fourier transform) as the data collected is much more (Etgen '759: Col.1 Lines 40-45). Combing the two reference will yield more truer picture 3-D geological model (Etgen '759: Col.3 Lines 14-20) and perturbation will make the model more precise to actual (Gelfand '174: Abstract).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to take the teachings of Jones '643 and apply them to Etgen '759 to create frequency-passband geological model. The motivation would have been that frequency pass-band based geological models proposed by the Etgen '759 are not optimized based on the ability to perturb individual rock properties and Jones '643 provides that capability (Jones '643: Col.6 Lines 62-65) leading to better trained model based on iteration. Further motivation to combine comes from Etgen '759 as performing transformation speeds up the depth-amplitude-time seismic data processing (Etgen '759: Col.5 Lines 41-58; Jones '643: Col.10 Lines 38-41).

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to take the teachings of Gelfand '174 with Jones '643 to create 3-D geological model where rock properties are perturbed to enhance the model. The motivation would have been that Gelfand '174 performs the same process as Jones '643, but builds a 2-D geological model (Gelfand '174: Abstract) where as Jones '643 teaches how to build a 3-D geological model with separate objective function to accuracy of the model (Jones '643: Abstract).

Regarding Claim 19

Etgen '759 teaches that rock properties are measurable properties consisting of P velocity, S velocity, attenuation/dissipation (Q), density, porosity, and permeability (Etgen '759: Col.17 Lines 58-63)(Gelfand '174: Col.2 Lines 1-3).

Regarding Claim 20

Gelfand '174 teaches that rock properties assigned to the model can be verified with the real well data (Gelfand '174: Col.2 Lines 4-12).

Regarding Claim 21 & 22

Etgen '759 teaches geologic model can be made from one frequency or a summation of frequencies (frequency-passband)(Etgen '759: Col7 Lines 18-35).

Regarding Claim 23

Etgen '759 teaches summation of frequency models as detailed in claim 11 above. Further, weighted summation is understood as convolution before summation, taught by Etgen '759, performed with frequency specific seismic data in frequency domain (through Fourier Transform) (Etgen '759: Col.5 Lines 41-51). Further, frequency filtering is performed so weighted summation of frequency models is not needed as overlaps are reduced (Etgen '759: Figure 2 Element 100).

Regarding Claim 24

Jones '634 teaches perturbing the rock-property values comprises a series of sequential steps, wherein each step attempts to force a nearly perfect fit of the model statistics to one of the training criteria (Jones '634: Abstract Lines 12-18).

Regarding Claim 25

Jones '634 teaches replacing rock property values in a block with values from the corresponding value from the intersecting well-borehole data (Jones '634: Col.13 Lines 61-67).

Regarding Claim 27

Gelfand '174 teaches that every parameter of the rock property is perturbed (Gelfand '174: Col.9, Lines 25-27).

Regarding Claim 28

Jones '643 teaches that training criteria are specified for each region depending on the realistic and accurate data (from borehole & well data), hence is unique to that region (Jones '643: Col.8 Lines 51-55; Col.9 Lines 59-63).

Regarding Claim 29

Jones '643 teaches that steps performed above are conducted on the digital computer (Jones '643: Col. 11 Lines 66-67, Col.12 Lines 1-2).

7. **Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,049,759 issued to John T. Etgen (Etgen '759 hereafter), in view of U.S. Patent No. 4,679,174 issued to Valery A. Gelfand (Gelfand '174 hereafter), further in view of U.S. Patent No. 5,838,634 issued to Thomas A. Jones et al (Jones '634 hereafter), further in view of applicant's own admission.**

<u>Regarding Claim 26</u>

Teachings of Etgen '759, Gelfand '174 & Jones '634 are disclosed above.

Etgen '759, Gelfand '174 & Jones '634 do not teach the limitations disclosed in claim 26.

Applicant's attention is draw to specification page 22 section (b) stating

> "<u>Tentative porosity values assigned to all blocks in the geologic model are simultaneously perturbed to new values using the rank-transform method. This method, known to persons skilled in the art of geologic modeling</u>, resets the tentative cumulative frequency distribution of porosity calculated from the tentative geologic model to the desired cumulative frequency distribution of porosity. This step simultaneously perturbs rock property values in all blocks of the complete geologic model."

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to use techniques known in the art to reset the tentative cumulative frequency distribution of porosity calculated from the tentative geologic model to the desired cumulative frequency distribution of porosity. Motivation to combine is the knowledge of persons of ordinary skill in the art (MPEP 2143.01).

Remarks

1. All claims are rejected.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Akash Saxena whose telephone number is (571) 272-8351. The examiner can normally be reached on 8:30 - 5:00 PM M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jean R. Homere can be reached on (571)272-3780. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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May 20, 2005

JEAN R. HOMERE
PRIMARY EXAMINER